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# Lateral carbon fluxes and $CO_2$ outgassing from a tropical peat-draining river

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**Abstract.** Tropical peatlands play an important role in the global carbon cycle due to their immense carbon storage capacity. However, pristine peat swamp forests are vanishing due to deforestation and peatland degradation, especially in Southeast Asia. $CO_2$ emissions associated with this land use change might not only come from the peat soil directly but also from peat-draining rivers. So far, though, this has been mere speculation, since there has been no data from undisturbed reference sites. We present the first combined assessment of lateral organic carbon fluxes and $CO_2$ outgassing from an undisturbed tropical peat-draining river. Two sampling campaigns were undertaken on the Maludam River in Sarawak, Malaysia. The river catchment is covered by protected peat swamp forest, offering a unique opportunity to study a peat-draining river in its natural state, without any influence from tributaries with different characteristics. The two campaigns yielded consistent results. Dissolved organic carbon (DOC) concentrations ranged between 3222 and 6218 µmol $L^{-1}$ and accounted for more than 99 % of the total organic carbon (TOC). Radiocarbon dating revealed that the riverine DOC was of recent origin, suggesting that it derives from the top soil layers and surface runoff. We observed strong oxygen depletion, implying high rates of organic matter decomposition and consequently $CO_2$ production. The measured median $pCO_2$ was 7795 and 8400 µatm during the first and second campaign, respectively. Overall, we found that only $32 \pm 19$ % of the carbon was exported by $CO_2$ evasion, while the rest was exported by discharge. $CO_2$ outgassing seemed to be moderated by the short water residence time. Since most Southeast Asian peatlands are located at the coast, this is probably an important limiting factor for $CO_2$ outgassing from most of its peat-draining rivers.

## 1 Introduction

Southeast Asian peat soils are a globally important carbon pool. They store 68.5 Gt carbon, which corresponds to 11–14 % of the global peat carbon (Page et al., 2011). Peat consists of layered dead organic material. Decay is inhibited due to permanent waterlogging, low pH and scarcity of oxygen. The main reason for slow decomposition rates in peat is the enzyme phenol oxidase, which is activated by bimolecular oxygen (Freeman et al., 2001): at low oxygen and low pH, phenol oxidase activity is inhibited (Pind et al., 1994). That allows phenolic compounds to accumulate, which, in turn, inhibit those enzymes required for peat decomposition. Under natural conditions, organic matter accumulates faster than it decomposes, and the peatland acts as a net carbon sink. Coastal peatlands in Southeast Asia, in particular,